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February 18, 2008

**To:** Environmental Protection Agency  
Contracts Management Division  
26 West Martin Luther King Drive  
Cincinnati, OH 45268

**Attention:** Tammy A. Thomas  
Contracting Officer

**Subject:** Work Plan for Work Assignment 0-03, EPA Contract EP-C-05-028, under SwRI  
Project 03.13363, SwRI Proposal No. 08-51736.

Contract Title: "Broad Testing Support for In-Use Engines and Vehicles"

Assignment Title: "Fuel Parameter Influence on Vehicle Emissions for EPA  
Testing"

## **1.0 OVERVIEW**

The Energy Policy Act of 2005 requires that EPA produce an updated fuel effects model representing the 2007 light-duty gasoline fleet. The fuel matrices which are the subjects of this Statement of Work will be used in a vehicle test program that will generate the exhaust emission data needed to develop that model. Statistical design of the experimental methodology must be used to design the matrices.

## **2.0 SCOPE OF WORK**

The Test Plan for this Work Assignment (WA) follows the Statement of Work given in Appendix A. Southwest Research Institute® (SwRI) will generate several statistical test fuel matrix designs optimized for various ethanol blends and other fuel properties in compliance with the directions provided by EPA. In addition to designing the test fuel matrices, SwRI also will provide appropriate statistics regarding the efficiency of the generated designs.



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### 3.0 TASK 1: WORK PLAN DEVELOPMENT

SwRI staff will submit a work plan for EPA approval within 15 calendar days after receipt of this WA. The work plan will include a description of how the tasks will be performed.

### 4.0 TASK 2: QUALITY-ASSURANCE PROJECT PLAN (QAPP)

SwRI plans to use standard statistical methods in this project so no formal QAPP is required. The statistical tools to be used and how they are to be used to produce the deliverables in Task 4 are described in Section 5.0.

### 5.0 TASK 3: GENERATING FUEL MATRICES

SwRI will use five gasoline fuel properties, as specified by EPA, along with numeric ranges (levels) for them and generate fuel matrices that are statistically optimized to resolve differences between the five parameters as to their effect on vehicle exhaust emissions. This will be done by

- (1) specifying a set of candidate fuels based on a full factorial design and any fuel property restrictions or limitations,
- (2) specifying a linear regression model based on the five fuel properties and including designated two-way interactions and quadratic effects, and
- (3) choosing the design points so that the coefficients of the fuel properties in the model can be estimated as efficiently as possible.

An experimental design software package, ECHIP Version 7.01, will be used to computer generate the design matrices to meet the above conditions. The generated designs will be based on an algorithmic design procedure which optimizes the G-efficiency. G-efficiency is a measure of the goodness of the design and is defined as the ratio of the maximum variance of an optimal design to the maximum variance of a given design.

The five fuel properties will include Reid Vapor Pressure (RVP), Distillation Temperature at 50 Percent Evaporated (T50), Distillation Temperature at 90 Percent Evaporated (T90), Fuel Volume Percent Aromatics, and Volume Percent Ethanol. The design matrices will be developed from the five fuel properties at 2 levels for RVP, 5 levels for T50, 2 levels for T90, 2 levels for volume percent aromatics, 4 levels for ethanol. An **exception** was made to increase the levels for T50 from the 4 levels listed in the Work Statement to 5 levels after clarifying this with the Work Assignment Manager. It is assumed that the targets for the various levels will be provided by the Work Assignment Manager via written direction.



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## 6.0 REPORTING AND DELIVERABLES

Fuel matrix designs and associated statistics will be delivered, as needed, on or before March 15, 2008. The format for the designed fuel matrices will be in Microsoft Excel format. An **exception** will be made to the format of the statistics. Since the only statistic to be generated is the G-efficiency for each design, the statistic will be printed in the Excel file with the design. As indicated in the Statement of Work, no formal written report will be prepared.

## 7.0 STAFF ASSIGNMENTS

The Project Manager will be Dr. Robert L. Mason, who will also act as Principal Investigator. Ms. Janet P. Buckingham will assist in developing the statistical test matrices. Dr. Mason and Ms. Buckingham are members of The Statistics Group at SwRI and are staff members within the Fuels and Lubricants Research Division (Division 08).

## 8.0 PROJECTED LABOR HOURS AND OTHER DIRECT COSTS

Based on our understanding of Work Assignment 0-03, we project the breakdown of employee utilization by labor category as detailed in Table 1. Complete cost detail is presented in the attached cost breakdown given in Attachment B.

**TABLE 1. PROJECTED LABOR HOURS FOR AMENDMENT 1 TO WORK  
ASSIGNMENT 2-2**

Labor Category	Hours
PL4	<b>Ex. 4 - CBI</b>
PL3	
Total Technical Hours	



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## 9.0 SUMMARY

Southwest Research Institute has responded to Work Assignment 0-03 with the two exceptions as noted in Sections 5.0 and 6.0 above. Should any questions of a technical nature arise, please contact Dr. Robert L. Mason at 210-522-2671. If there are questions regarding cost or contractual issues, please contact Ms. Sherry Twilligear at 210-522-3948. Thank you for this opportunity to be of service.

Prepared by:

*Robert L. Mason*

Robert L. Mason  
Institute Analyst  
Fuels and Lubricants Research Division

Approved by:

*Walter P. Groff, Jr.*

Walter P. Groff, Jr.  
Senior Vice President  
Office of Automotive Engineering

cc: Sherry Twilligear, SwRI Contracts



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**ATTACHMENT A**  
**WORK ASSIGNMENT 0-03**

EPA Form 1900-89 (Rev. 07-95)

## **Performance Work Statement**

Contract EP-C-07-028	Work Assignment Number 0-03
Issuing Office	Environmental Protection Agency 2000 Traverwood Drive Ann Arbor, MI 48105-2498
Contractor	Southwest Research Institute 6220 Culebra Rd. San Antonio, TX 78228-0510
Title	Fuel Parameter Influences on Vehicle Emissions for EPA Testing

### **Background**

Section 1506 of the Energy Policy Act of 2005 (Energy Act) requires EPA to produce an updated fuel effects model representing the 2007 light duty gasoline fleet, including determination of the emissions impacts of increased renewable fuel use.

The use of ethanol in gasoline has increased more than five-fold since 2000, and it is likely that its use will continue to expand into the next decade. It is also likely that use of ethanol blends at 10% or greater will expand significantly.

Recent investigation related to the Mobile Source Air Toxics (MSAT2) rulemaking has shown that hydrocarbon emissions from light duty gasoline vehicles increase significantly as test temperature is decreased. As a result, the MSAT2 rulemaking promulgated Non-Methane Hydrocarbon (NMHC) standards at 20°F. However, this being a relatively new area of study, fuel effects data at temperatures lower than 75°F is scarce for use in emissions models.

Hydrocarbon (HC) emissions are composed of hundreds of compounds, some of which have been identified by the EPA as air toxics. The Clean Air Act directs EPA to set standards to reduce air toxics emissions. Most existing data on the fractional relationship between the various air toxics and HC emissions has been established using vehicles meeting Tier 0 emissions standards (now more than 10 years old), and burning fuels that did not contain ethanol.

### **Scope and Objectives**

This Work Assignment (WA) is to assure that the Phase 3 test fuels to be used in WA 0-1 of this contract are correctly specified and will meet the needs of that test program.

### **Task 1 Work Plan Development**

The contractor shall submit a work plan for EPA approval within 15 calendar days after receipt of this WA. The work plan shall include a description of how the tasks described below are to



be performed.

### **Task 2 Quality-Assurance Project Plan (QAPP)**

If the contractor uses standard statistical methods then no formal QAPP is required, however, the contractor shall indicate, in the work plan, what statistical tools are to be used and how they are to be used to produce the deliverables in Task 4. If standard statistical methods are not used, the contractor shall notify the Work Assignment Manager (WAM) immediately.

### **Task 3 Generating Fuel Matrices**

The contractor shall take 5 gasoline fuel parameters along with numeric ranges (levels) for them and generate fuel matrices that are statistically optimized to resolve differences between the five parameters as to their effect on vehicle exhaust emissions. In addition to the design the contractor shall provide appropriate statistics concerning the 'efficiencies' of the various designs to predict the effect of the 5 parameters on vehicle emissions.

The 5 parameters are Reid Vapor Pressure (RVP), Distillation Temperature at 50 Percent Evaporated (T50), Distillation Temperature at 90 Percent Evaporated (T90), Fuel Volume Percent Aromatics, and Volume Percent Ethanol. The matrices will be developed from the five parameters at 2 levels for RVP, 4 levels for T50, 2 levels for T90, 2 levels for volume percent aromatics, and 4 levels for volume percent ethanol. The targets for the various levels will be provided to the contractor by the Work Assignment Manager via written technical direction.

### **Task 4 Reporting and Deliverables**

Fuel matrix designs and associated statistics shall be delivered on or before March 15, 2008. The format for the matrix shall be in Microsoft Excel and the statistics in a common text file format that the contractor has on hand. No formal written report is required.

Work Assignment Manager (WAM)	Rafal Sobotowski, 734/ 214-4228
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Alternate WAM	Constance Hart, ASD 734/214-4340
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**ATTACHMENT B**

**COST PROPOSAL FOR WORK ASSIGNMENT 0-03**

# Ex. 4 - CBI

# **Ex. 4 - CBI**

**COST BREAKDOWN**

# Ex. 4 - CBI

# Ex. 4 - CBI

# Ex. 4 - CBI



# Ex. 4 - CBI

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